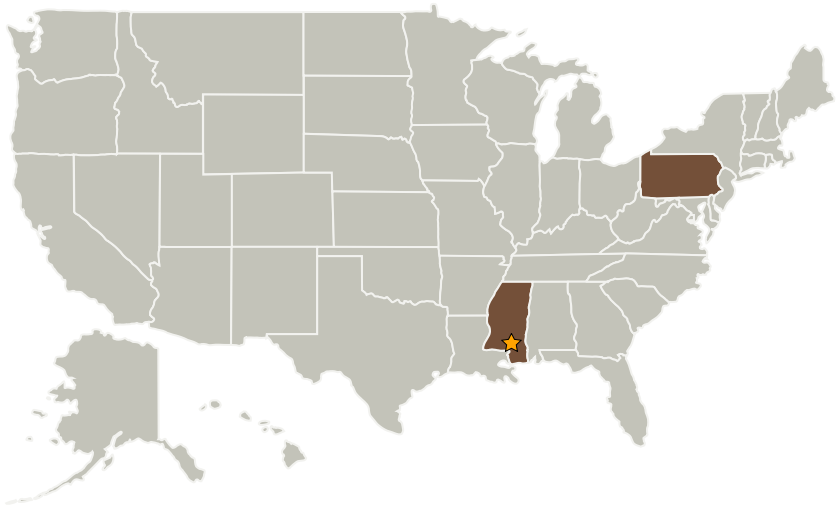
Integrated Component and System Analyses of Instabilities in Test Stands, Phase I

Completed Technology Project (2009 - 2010)

Project Introduction

Instabilities associated with fluid handling and operation in liquid rocket propulsion systems and test facilities usually manifest themselves as structural vibrations and may cause structural damage such as the cracks observed in the space shuttle hydrogen feed liners. While the source of the instability is directly related to the performance of a component such as a turbopump, valve or a flow control element, the associated pressure fluctuations as they propagate through the system have the potential to amplify and resonate with natural modes of the structural elements and components of the system. The innovation described in this proposal directly relates to an innovative multi-level approach that involves integration of analysis, at both the component and systems level, into a unified simulation framework. The primary source of the unsteadiness is modeled with a high-fidelity hybrid RANS/LES based CFD methodology that has been previously used to study instabilities in feed systems. System response to the driving instability will be simulated through a lumped element modeling (LEM) technique that will approximate the behavior of all the distributed elements that constitute the system.

Primary U.S. Work Locations and Key Partners



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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Stennis Space Center (SSC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

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Organizations Performing Work	Role	Type	Location
★Stennis Space Center(SSC)	Lead Organization	NASA Center	Stennis Space Center, Mississippi
CRAFT Tech - Combustion Research and Flow Technology	Supporting Organization	Industry	Pipersville, Pennsylvania

Primary U.S. Work Locations	
Mississippi	Pennsylvania

Project Transitions

January 2009: Project Start

January 2010: Closed out

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Technology Areas

Primary:

- TX15 Flight Vehicle Systems
  - TX15.2 Flight Mechanics
    - TX15.2.2 Flight Performance and Analysis